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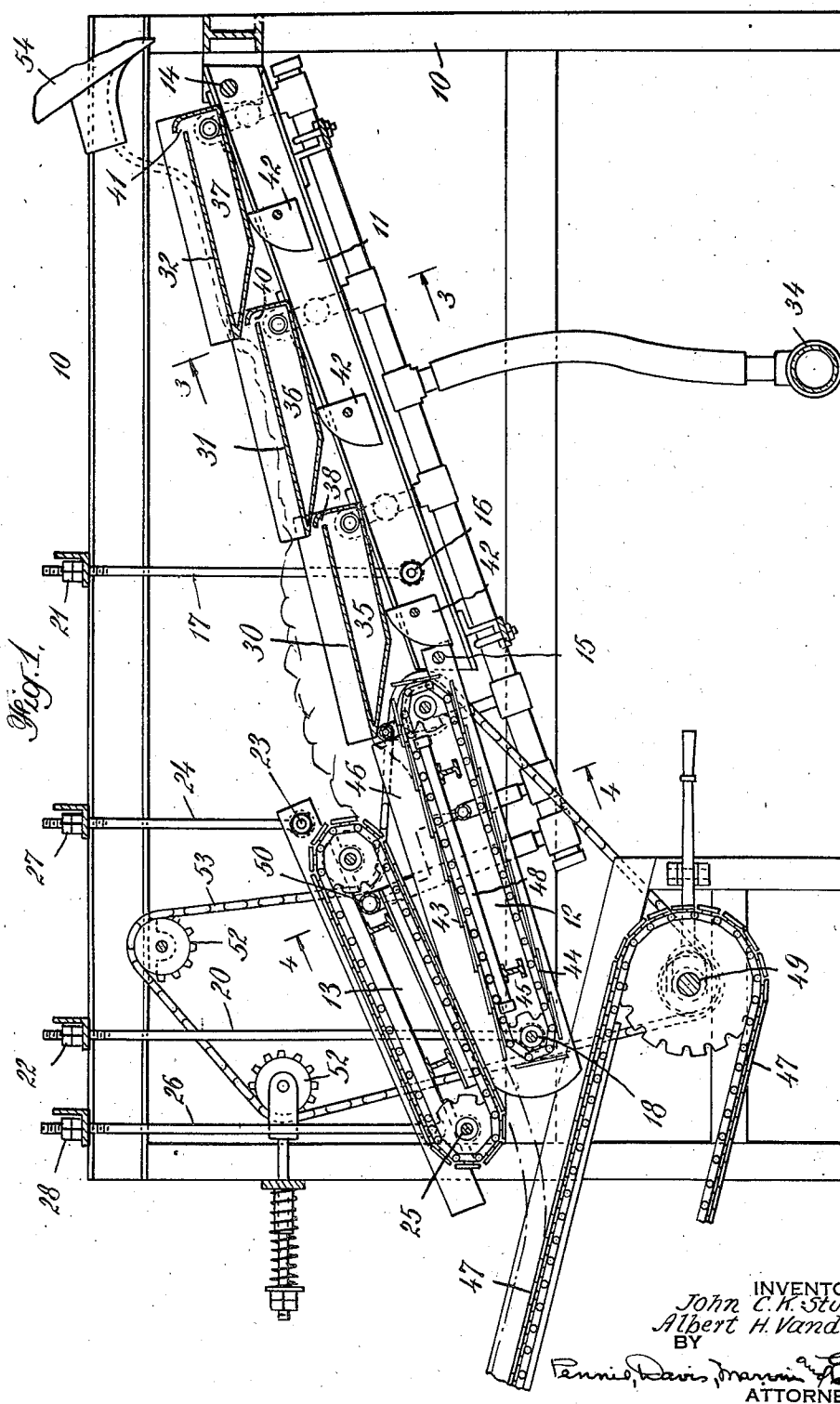
J. C. K. STUART ET AL

2,428,249

APPARATUS FOR PUFFING SLAG

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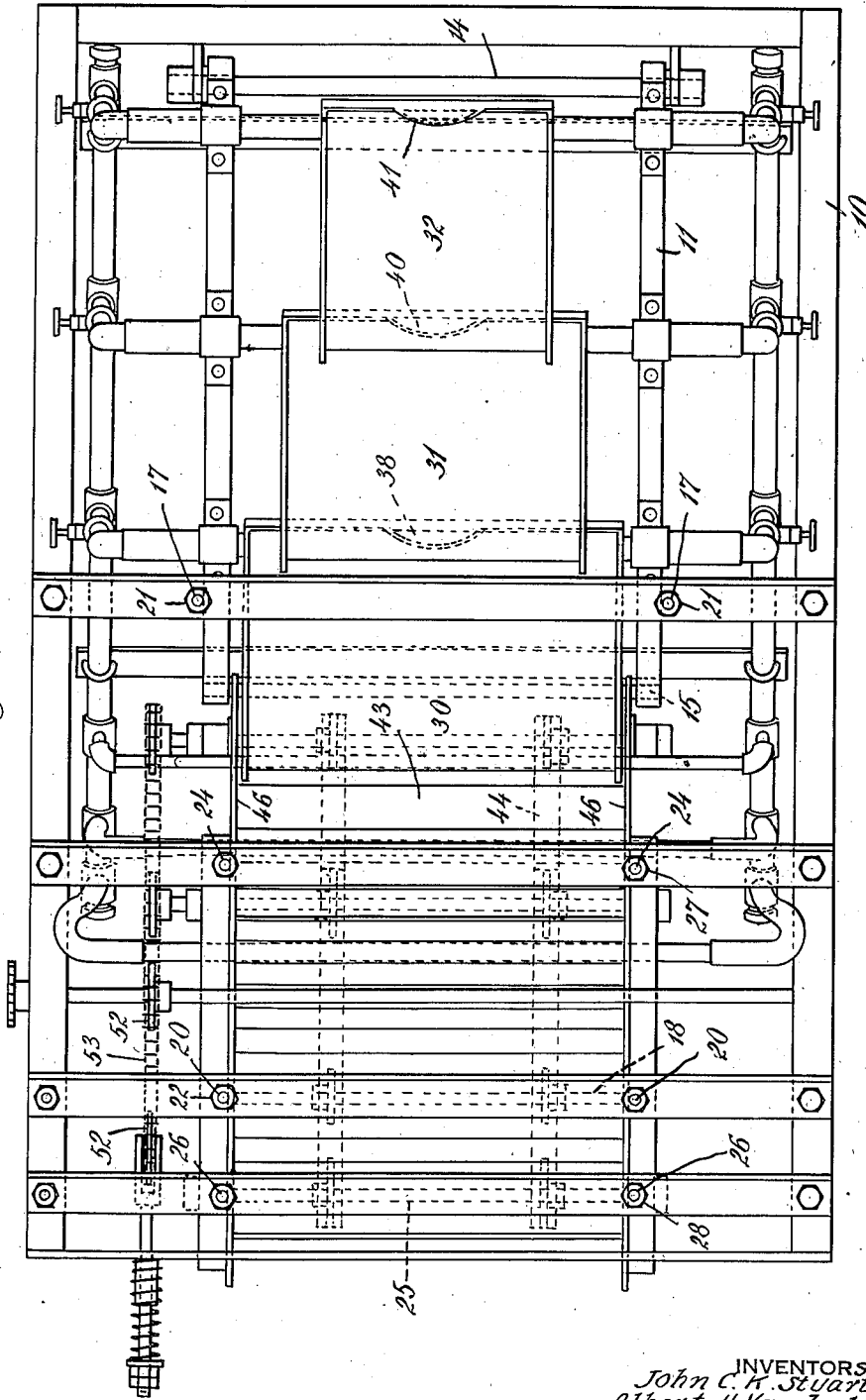
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Fig. 2



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Fig. 3,

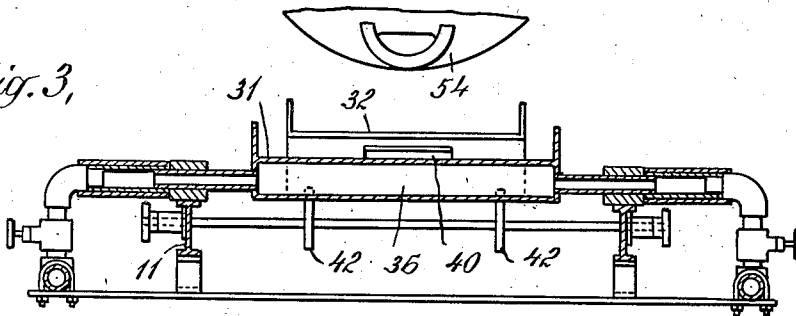


Fig. 4,

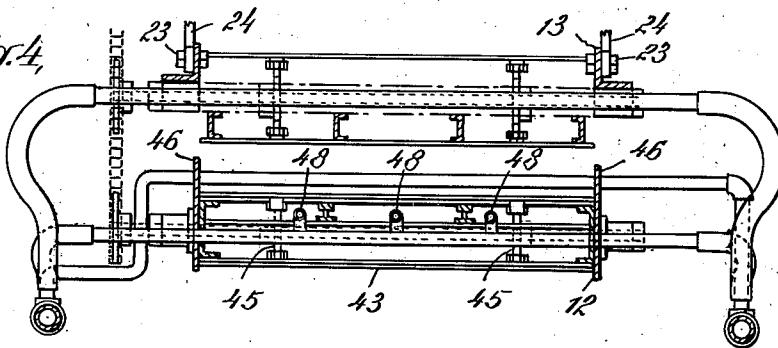


Fig. 5,

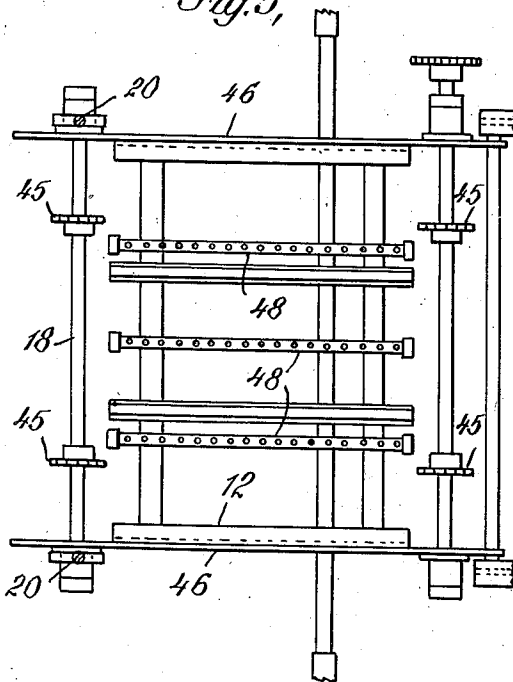
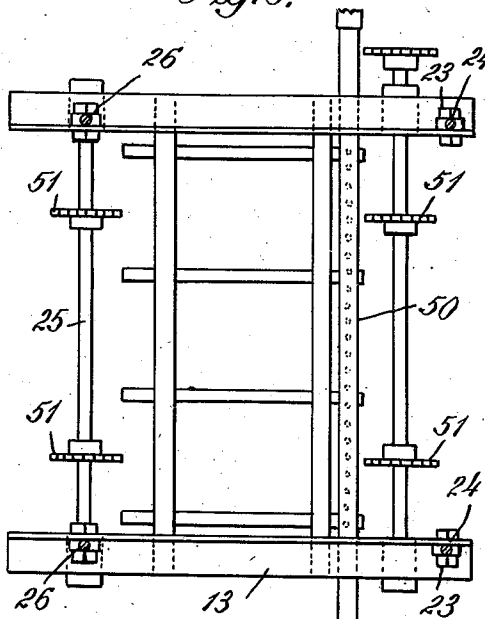


Fig. 6.



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2,428,249

APPARATUS FOR PUFFING SLAG

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4 Claims. (Cl. 49—1)

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This invention relates to the puffing or expanding of molten slag to produce porous slag products and has for an object the provision of an improved apparatus for producing such products. More particularly, the invention contemplates the provision of an improved apparatus for producing porous puffed slag products of predetermined volumes relatively to the volumes of the original molten slags employed.

According to some heretofore customary practices, puffed light-weight porous slag products are produced by subjecting molten blast furnace slags to the action of puffing liquids capable of vaporizing under the influence of heat contained in the slags to effect vaporization of the puffing liquids and puffing, foaming or swelling of the molten slags into porous plastic masses of substantially greater volumes than the volumes of the original molten slags, and cooling the porous plastic masses to form solid porous puffed slag products. Such a process is described in our United States Patent No. 2,212,962, dated August 27, 1940.

Some slags, particularly very hot slags of minor aluminum contents, puff or swell to such an extent, in spite of most careful control of relative proportions of slag and puffing liquid and time of contact, that the resulting puffed slag product is of such low structural strength as to be practically worthless commercially.

The present invention is based on our discovery that foamed, puffed, expanded or swelled slag masses can be pressed, squeezed or compressed, while still in the plastic state into smaller volumes without breaking the porous structures of the masses, but with reduction in size of the larger cells or pores and increases in the strengths of the walls of the finer or smaller cells or pores and with resultant increases in the structural strengths of the ultimate products.

According to the invention, molten slag is contacted with a puffing liquid such as water capable of vaporizing under the influence of heat contained in the slag to produce vapor which causes swelling or puffing of the molten slag into a porous plastic mass of substantially greater volume than the volume of original slag, and the resulting porous plastic mass is subjected to a pressing, compressing or squeezing operation to form a product of predetermined volume relatively to the volume of original molten slag.

In a complete preferred apparatus of the invention, the porous plastic mass is produced by contacting an inclined surface with a puffing liquid (such as water), depositing molten slag on

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the inclined surface so contacted with the puffing liquid, discharging the slag from said inclined surface onto a second inclined surface, introducing additional puffing liquid onto the second inclined surface beneath the slag discharged thereon from the first inclined surface to re-establish contact between the bottom of the slag and the puffing liquid, the amount and force of the puffing liquid introduced onto said inclined surfaces being so correlated to the amount of slag deposited thereon and the inclination of said surfaces being such that the vapor produced by contact of the slag and liquid causes swelling or puffing of the molten slag into a porous plastic mass of substantially greater volume than the volume of original slag, and withdrawing the slag from contact with the puffing liquid in the form of a porous plastic mass. Such a method or process is described in our aforementioned United States Patent No. 2,212,962.

The pressing, compressing or squeezing operation may be carried out in any suitable manner. In the preferred apparatus of the invention, the pressing, compressing or squeezing operation is carried out by passing or conducting the porous plastic mass through a passage of restricted cross-section. In the preferred complete apparatus, the porous plastic mass is passed or conducted between conveyors so disposed as to form a passage of restricted cross-section therebetween and so operated as to cause the porous plastic mass to move through the passage and thereby be reduced in volume.

Apparatus of the invention comprises means for treating molten slag to form a porous plastic mass of substantially greater volume than the volume of the original molten slag, and means for pressing, compressing or squeezing the porous plastic mass to form a product of predetermined volume.

Apparatus of the invention comprises means for contacting molten slag with a puffing liquid capable of vaporizing under the influence of heat contained in the slag to effect vaporization of the puffing liquid and puffing or swelling of the molten slag into a porous plastic mass of substantially greater volume than the volume of original molten slag, and means for pressing, compressing or squeezing the porous plastic mass to form a product of predetermined volume. A preferred form of apparatus of the invention comprises a passage of restricted cross-section, and means for passing the porous plastic mass through the passage to reduce its volume and form a product of predetermined volume rela-

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tively to the volume of molten slag. In a preferred form of apparatus of the invention, the pressing, compressing or squeezing means comprises conveyors so disposed as to form a passage of restricted cross-section therebetween, means for introducing the porous plastic mass into the passage between the conveyors, and means for so operating the conveyors as to cause the porous plastic mass to move through the passage and thus effect a reduction in volume of the porous plastic mass with the production of a product of predetermined volume.

A complete preferred form of apparatus of the invention comprises two or more inclined puffing trays mounted in stepped relationship to permit a mass of slag to flow downwardly thereover from the initial or uppermost tray to the lowermost tray in order to accomplish progressive or multiple-stage puffing of the slag, means for supplying puffing liquid to said trays, conveyors so disposed as to form a passage of restricted cross-section therebetween, means for introducing the porous plastic mass into the passage between the conveyors, and means for so operating the conveyors as to cause the porous plastic mass to move through the passage and thus effect a reduction in volume of the porous plastic mass with the production of a product of predetermined volume.

The invention will be better understood from a consideration of the following description in conjunction with the accompanying drawings, showing a preferred embodiment of the apparatus suitable for use in practicing the invention and in which

Fig. 1 is a sectional elevation of apparatus including pressing, compressing or squeezing conveyors;

Fig. 2 is a plan of the apparatus shown in Fig. 1;

Fig. 3 is a section taken substantially along the line 3—3 of Fig. 1;

Fig. 4 is a section taken substantially along the line 4—4 of Fig. 1;

Fig. 5 illustrates the cooling means for the lower pressing, compressing or squeezing conveyor; and

Fig. 6 illustrates cooling means for the upper pressing, compressing or squeezing conveyor.

The apparatus shown in the drawings comprises a rigid supporting frame 10 on which are mounted a puffing tray supporting frame 11, a lower conveyor assembly 12 and an upper conveyor assembly 13. The puffing tray supporting frame and the trays thereon and the lower conveyor assembly provide an inclined path of flow for slag. The upper conveyor assembly is so disposed as to cooperate with the lower conveyor assembly to provide means for controlling the volumes of puffed slag products produced. The puffing tray supporting frame 11 is pivotally attached at its upper end-portion by means of a horizontally disposed pivot 14 to the rigid supporting frame 10. The lower end-portion of the puffing tray supporting frame 11 is pivotally attached at 15, by means of a horizontally disposed pivot, to the upper end-portion of the lower conveyor assembly 12.

The lower end-portion of the puffing tray supporting frame 11 is pivotally attached at 16 to the lower end-portions of hangers or supporting rods 17 which are adjustably supported by an upper horizontal member of the stationary supporting frame 10. The lower end-portion of the lower conveyor assembly 12 is attached by means of a pivot or shaft 18 to the lower end-portions

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of hangers or supporting rods 20. The inclinations of the puffing tray supporting frame 11 and the lower conveyor assembly 12 may be adjusted by manipulating the nuts 21 and 22 on the upper threaded end-portions of the supporting rods or hangers 17 and 20.

The upper end-portion of the upper conveyor assembly 13 is pivotally attached at 23 to the lower end-portions of hangers or supporting rods 24 which are adjustably supported by an upper horizontal member of the stationary supporting frame 10. The lower end-portion of the upper conveyor assembly 13 is attached by means of a pivot or shaft 25 to the lower end-portions of hangers or supporting rods 26. The inclination of the upper conveyor assembly 13 and its vertical position relatively to the lower conveyor assembly may be adjusted by manipulating the nuts 27 and 28 on the upper threaded end-portions of the supporting rods or hangers 24 and 26.

Puffing trays 30, 31 and 32 are so mounted on the puffing tray supporting frame as to form a chute for the passage of slag therethrough from the uppermost to the lowermost and onto the lower conveyor assembly 12. The puffing trays are pivotally attached at their upper ends to the puffing tray supporting frame by means of hollow trunnions which, in turn, are connected to a source of supply of water and serve as conduits for conducting water from the water main 34 for use as puffing liquid to the puffing trays. Water is delivered to chambers 35, 36 and 37 in the puffing trays and passes to the upper flat surfaces of the trays through slots 38, 40 and 41 in the upper end-portions of the trays. Suitable flexible connections are provided between the puffing tray chambers and the source of supply of water to permit adjustment of the inclinations of the trays. Cams 42 together with suitable cam shafts and operating handwheels or other manipulating devices are provided to permit adjustment of the inclinations of the puffing trays.

The lower conveyor assembly 12 comprises a series of overlapping metal slats 43 mounted on roller chains 44 which are supported and driven by gears or sprockets 45. The lower conveyor assembly includes, also, sidewalls 46 attached to the supporting frame and between which the upper conveyor assembly is adapted to fit rather closely. The upper conveyor is similar in structure to the lower conveyor except that the edges of the slats are flush rather than overlapping.

The upper conveyor assembly and the lower conveyor assembly are so connected mechanically with a source of power 49 that the conveyors are driven in opposite directions, that is, the lower surface of the upper assembly and the upper surface of the lower assembly move in the same direction. The source of power 49 also provides the power or force necessary to drive a porous metal slat conveyor 47 to which puffed slag is delivered from the lower conveyor assembly 12.

Figs. 5 and 6 show cooling arrangements connected with the water main for cooling the lower and upper conveyor assemblies, respectively. Spray pipes 48 extend longitudinally of the lower conveyor assembly, and the spray pipe 50 extends transversely of the upper conveyor assembly. Gears or sprockets 51 support the roller chains which support the metal slats of the upper conveyor assembly. Gears 52 and the driving chain 53 are so arranged as to drive the conveyors of the upper and lower conveyor assemblies in opposite directions.

In the use of the apparatus of the invention, molten slag is poured from a ladle 54 onto the uppermost puffing tray 32 from which, as described in our aforementioned United States patent, it passes to other lower trays in series with progressive puffing. From the lowermost puffing tray, it passes between the upper and lower conveyor assemblies 12 and 13.

The upper and lower conveyor assemblies are so arranged as to form a passage of restricted but variable or adjustable cross-section. The conveyor assemblies conduct or force the puffed slag through the passage therebetween, and slag which has been foamed or puffed to an undesirable extent will be reduced in volume to a desired extent. The relative positions of the upper and lower conveyor assemblies can be so adjusted that a product of predetermined volume relatively to the volume of original molten slag can be obtained.

The invention provides for the production of solid puffed slag products of suitable physical characteristics regardless of the compositions of the slags employed, within certain limits, and without the necessity for strict control of relative proportions of puffing liquid and slag employed to accomplish puffing.

We claim:

1. Apparatus for puffing slag comprising at least two inclined surfaces mounted in stepped relationship to permit a mass of slag to flow downwardly thereover from the uppermost surface to the lowermost surface in order to accomplish progressive or multiple-stage puffing of the slag, means for adjusting the inclination of said surfaces, means for supplying a regulated quantity of water to an upper section of each of said inclined surfaces, a pair of spaced, endless conveyors positioned one above the other in line with the flow of puffed slag passing from the lowermost of said inclined surfaces, the receiving end of the lower conveyor being located adjacent the discharge edge of the lowermost of said inclined surfaces to receive puffed slag discharged from the same, the upper conveyor being so inclined to the lower conveyor that it is spaced farther from the lower conveyor at the receiving end thereof to form a wider entrance opening for receiving puffed slag discharged from the lowermost of said inclined surfaces, the upper conveyor gradually converging towards the discharge end of the lower conveyor, said conveyors forming a passage of restricted cross-section through which puffed slag from said inclined surfaces may be passed and gradually compressed, and means for adjusting the position, vertically, of one of said conveyors relative to the other conveyor to vary the extent to which puffed slag passing through the passageway between said conveyors is compressed, whereby by regulation of the inclination of said surfaces, the amount of water supplied thereto and the relative position of said conveyors, vertically, to one another, the extent to which the slag discharged from between said conveyors is puffed and the texture and physical strength thereof may be determined.

2. Apparatus for puffing slag comprising a tray assembly including at least two puffing trays having inclined surfaces mounted in step relationship to permit a mass of slag to flow downwardly thereover from the uppermost surface to the lowermost surface of said trays in order to accomplish progressive or multiple-stage puffing of the slag, means for adjusting the inclination of said tray assembly, including said inclined sur-

faces of said puffing trays, means for supplying a regulated quantity of water to an upper section of each of said inclined surfaces of said trays, a pair of spaced, endless conveyors positioned one above the other in line with the flow of puffed slag passing from the lowermost of said puffing trays, the lower conveyor being pivoted to said assembly and having its receiving end located adjacent the discharge edge of the lowermost of said trays to receive puffed slag discharged therefrom, the upper conveyor being so inclined to the lower conveyor that it is spaced farther from the lower conveyor at the receiving end thereof to form a wider entrance opening for receiving puffed slag discharged from the lowermost of said trays, the upper conveyor gradually converging toward the discharge end of the lower conveyor, said conveyors forming a passage of restricted cross-section through which puffed slag from said puffing trays may be passed and gradually compressed, and means for adjusting the position, vertically, of the upper conveyor relative to the lower conveyor to vary the extent to which puffed slag passing through the passageway between said conveyors is compressed, whereby, by regulation of the inclination of the inclined surfaces of said puffing trays, the amount of water supplied thereto and the relative position of said upper conveyor, vertically, to the lower conveyor the extent to which the slag discharged from between said conveyors is puffed and the texture and physical strength thereof may be determined.

3. Apparatus for puffing slag comprising at least two inclined surfaces mounted in stepped relationship to permit a mass of slag to flow downwardly thereover from the uppermost surface to the lowermost surface in order to accomplish progressive or multiple-stage puffing of the slag, means for adjusting the inclination of said surfaces, means for supplying a regulated quantity of water to an upper section of each of said inclined surfaces, a pair of spaced, endless conveyors positioned one above the other in line with the flow of puffed slag passing from the lowermost of said inclined surfaces, the receiving end of the lower conveyor being located adjacent the discharge edge of the lowermost of said inclined surfaces to receive puffed slag discharged from the same, the upper conveyor being so inclined to the lower conveyor that it is spaced farther from the lower conveyor at the receiving end thereof to form a wider entrance opening for receiving puffed slag discharged from the lowermost of said inclined surfaces, the upper conveyor gradually converging towards the discharge end of the lower conveyor, said conveyors forming a passage of restricted cross-section through which puffed slag from said inclined surfaces may be passed and gradually compressed, and means for adjusting the vertical position of the upper conveyor and the inclination thereof to the lower conveyor to vary the extent to which puffed slag passing through the passageway between said conveyors is compressed and the distance between said conveyors at the entrance to said passageway, whereby, by regulation of the inclination of said surfaces, the amount of water supplied thereto and the relative position of said conveyors, vertically, to one another, the extent to which the slag discharged from between said conveyors is puffed and the texture and physical strength thereof may be determined.

4. Apparatus for puffing slag comprising at least two inclined surfaces mounted in stepped relationship to permit a mass of slag to flow down-

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wardly thereover from the uppermost surface to the lowermost surface in order to accomplish progressive or multiple-stage puffing of the slag, means for adjusting the inclination of said surfaces, means for supplying a regulated quantity of water to an upper section of each of said inclined surfaces, a pair of spaced, endless conveyors positioned one above the other in line with the flow of puffed slag passing from the lowermost of said inclined surfaces, side walls at each side of said lower conveyor, the upper conveyor being positioned, vertically, between said side walls, the receiving end of the lower conveyor being located adjacent the discharge edge of the lowermost of said inclined surfaces to receive puffed slag discharged from the same, the upper conveyor being so inclined to the lower conveyor that it is spaced farther from the lower conveyor at the receiving end thereof to form a wider entrance opening and receiving puffed slag discharged from the lowermost of said inclined surfaces, the upper conveyor gradually converging towards the discharge end of the lower conveyor, said conveyors and said side walls forming a passage of restricted cross-section through which puffed slag from said inclined surfaces may be passed and gradually compressed, and means for adjusting the position, vertically, of one of said conveyors relative to the other conveyor to vary

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the extent to which puffed slag passing through the passageway between said conveyors is compressed, whereby by regulation of the inclination of said surfaces, the amount of water supplied thereto and the relative position of said conveyors, vertically, to one another, the extent to which the slag discharged from between said conveyors is puffed and the texture and physical strength thereof may be determined.

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